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EDITORIAL NOTES

WAR DAMAGE INSURANCE

GAS and other public utility undertakings, as well as all the manufacturers, traders, and commercial businesses associated with them, come within the scope of the new war damage insurance schemes to be instituted by the Board of Trade under the War Damage Act, 1941, which received the Royal Assent last week. Although it has been mentioned in the Press that a further Bill would probably cover damage to railways and other public utility undertakings, it was officially stated at a Press conference at the Board of Trade offices last Friday that at present such undertakings came under the present Act, and the only question to be settled was whether there was any case for treating them separately as regards compulsion. "That is rather in the air at the moment," it was said, "and there may be some amendment in that direction."

Part 2 of the Act, to be administered by the Board of Trade, relates to movable property, plant, machinery, business equipment, farm implements, crops, livestock and produce, furniture, clothing and personal effects, and there are to be three distinct insurance schemes, one for businesses, one for farmers, and a third for householders and other owners of "private chattels." These schemes differ from the compensation scheme for land and buildings and are distinct from the commodity insurance scheme which has been in operation for some time, and will be worked through the companies through whom the insured usually do their insurance business.

It is the Board's intention to have the business scheme in operation very soon after Easter, and the rest of the schemes not later than the end of April. To secure cover under any of the schemes the insurance must be taken out within 30 days from the date on which the particular scheme comes into force; anyone whose property is bombed within the period of 30 days will be regarded as covered provided he takes out a policy and pays the premium before the 30 days have elapsed. The Board realizes that representations may have to be made to it from time to time, and has expressed the hope that these may be made through recognized trade associations so that it may know how far they represent the interests of a trade as a whole. Nothing should be done until the Board has announced the dates on which the schemes are to be into force. Those who have filled up Form V.O.W. 1 need do nothing more unless otherwise instructed by the Board of Trade. If they have to fill up another form or supply more information the Board will make an announcement which will be given wide publicity.

Generally, payment for damaged property will be deferred until after the war, and interest at 2½% per annum will accrue from the date of the damage, but earlier payment may be made under the business scheme if the claim does not exceed £100, or if the Board is satisfied that replacement or repair is expedient in the public interest. Earlier payment may also be made under the private scheme if the claim does not exceed £25, or if the Board is satisfied that payment should be made to avoid undue hardship.

Under the business scheme, insurance (at 30s.%) is optional on goods worth £1,000 or less, but is compulsory on goods of greater value than £1,000, "goods" being described as everything in the way of business equipment for the purpose of carrying on the business. Insurance must be taken out for the full value, and manufacturers and traders are advised to insure for what it would cost them to replace the goods at the time of the loss, less a reasonable amount for depreciation. In cases where it is difficult to apply this basis of value, the Board will consider special difficulties with a view to working out a satisfactory basis; such cases should preferably be submitted or at least supported by a responsible trade association able to speak for the trade as a whole. Professional people come under the business scheme only in respect of their professional equipment; the rest of their belongings are insurable under the private scheme. To meet the case of small businesses, it has been decided that where the value of the business equipment does not exceed £100 it will be insurable under the private scheme.

In the case of private chattels there will be free compensation without payment of premium for furniture, clothing, and other personal effects up to certain limits, beyond which it will be possible to insure for any amount up to £10,000, with premiums at £1% up to £2,000, 30s.% for the next £1,000, and £2% for the next £7,000. There are certain restrictions on the amount of cover for such things as works of art and manuscripts, and not more than £50 or 5% of the total sum insured will be recoverable on any one article. Therefore it will be impossible to get more than £50 for a single article unless the insurance is for more than £1,000; if the policy is for £2,000 it will be possible to get up to £100, and if for £10,000, up to £500. An owner not insured and relying on free compensation cannot receive more than £25 in respect of any one article—even a car—but the position of cars generally is not yet quite clear, as some regard must be had to the extent to which any particular car is used for business purposes.

The business scheme covers local authorities, but special consideration is yet to be given to the position of equipment installed by them for community feeding. Government-owned property is not insurable under the Act, and it is possible that some special arrangement will be made to cover goods acquired by local authorities for what are deemed to be national purposes. Penalties may be imposed for offences under the Act. Business concerns failing to fulfil their obligation to insure under the compulsory scheme are liable to fines up to £100 and £50 per day for every day on which the offence is continued.

It is unlikely that the owner of a factory that has been closed under the concentration of industry movement will receive payment for war damage until after the war. On the other hand the nucleus factory in which manufacture has been concentrated will stand a better chance of receiving prompt payment than one that has not been affected by concentration.

It is announced that considerable sums in advance of final settlement of claims under the commodity insurance scheme of the War Risks Insurance Act have been paid to claimants within recent weeks. Printed directions attached to every claim form issued point out that where for any reason "there would be genuine hardship if some financial assistance is not afforded to the insured person pending ascertainment and settlement of the ultimate proved loss," the Board of Trade is prepared to entertain an application for payment on account. No special form is needed for this purpose, but the claimant wishing to apply for payment on account should write to his insurance company describing the nature, date, and cause of loss, and grounds of application for payment in advance of final settlement.

DISCOVERY AND INVENTION

ON several occasions we have heard Sir Richard Gregory address audiences composed of technical men, and to say he was interesting would do him an injustice. His subject last Wednesday, when he delivered the Aldred Lecture before the Royal Society of Arts, was "Discovery and Invention," and he suggested that science was concerned with discovery and the arts with invention, but "imaginative insight and constructive capacity are characteristics of both." He went on to say that scientific research may conveniently be divided into two classes—one in which the main motive is the discovery of new knowledge, while in the other the special purpose is to obtain results which have a direct bearing upon problems of manufacture and construction. The spirit of enquiry is the motive of scientific research.

It has, we think, taken some years for the Gas Industry to appreciate the desirability of having as part and parcel of its regular programme practical encouragement of this "spirit of enquiry." "A scientific discovery," remarked Sir Richard Gregory, "does not create anything new in Nature, but only reveals what had previously been unknown or overlooked," and he developed his theme with allusion to several examples of incidental and even accidental discoveries resulting from fundamental research. For example, the primary object of the experiments made by Crookes, Lenard, Röntgen and others, was not the invention of something of practical value, but to enquire into the nature of the electric discharge in gases, and of the rays emitted from electrodes in vaccum tubes. Science, not necessity, was the object of the researches which led to radio-telephony and broadcasting. "In general understanding, a scientific discovery is an addition to natural knowledge, and an invention an additional use of knowledge." Sir Richard Gregory maintained that the primary purpose of research laboratories of great industrial firms is profitable invention and not the discovery of scientific principles. What is called fundamental research, having no direct practical application, is often undertaken in such laboratories and leads to valuable contributions to scientific knowledge, but the main motive is directly industrial. It is now generally recognized that systematic research is an essential part of progressive industry, whether it be of a simple "trial-and-error" kind or into basic causes and consequences of properties and processes. To a certain extent such research has now become a professional career for which men may be trained, and in which they may be occupied with advantage to themselves and to the firms employing them.

Fortunately for itself and fortunately for the vast community it serves, the Gas Industry has realized the value of systematic and fundamental research—and is prepared to pay for it. In the "JOURNAL" this year, for example, we have published the results of work on radiation from solid substances under flame impact—the subject of an investigation undertaken at Leeds University by Mr. E. C. W. Smith, the Arthur Duckham Research Fellow. The work was described in the Second Arthur Duckham Research Fellowship Report which was published as a blue book (Communication No. 237) by The Institution of Gas Engineers. The work described has as its intention a rapid survey of the whole field of "candoluminescence" without any attempt at a detailed examination of particular aspects of the problem. It served to establish beyond all doubt the reality of the luminescent phenomenon at low temperatures. The existence of a luminescent radiation from solids in contact with flame is of considerable significance, as offering what appears to be the only hope of a considerable increase in the efficiency of light production from the combustion of fuel gases. At present and with the data available to date, the practical application of these luminescent substances would appear to be beset with considerable difficulties. The solving of these difficulties may reveal quite remarkable possibilities. From its theoretical aspects the subject is of great interest owing to its bearing on the subject of luminescence in general, and very little attention has been given to it in the past, apparently on account of the unsatisfactory nature of much of the experimental evidence.

The survey of luminescent materials so far completed has provided information which will be valuable in the selection of "activators" and parent substances. The establishment of a critical optimum concentration of any activator is of some importance. When other substances are examined it will be interesting to observe how this optimum concentration varies and on what factors it depends. Spectrographic examination, in addition to its theoretical implications, is of practical value in showing the distribution of the emission through the spectrum, and in demonstrating the possibility of securing almost any desired distribution—*e.g.*, one approximating to that of daylight—by the choice of a mixture of two or more luminescent materials. This type of work we regard as the "discovery of scientific principles," which may well lead to "profitable invention."

Personal

Sir ERNEST HILEY, K.B.E., has been appointed Chairman of Glover & Main, Ltd., Gas Engineers, and its Subsidiary Companies—Thomas Glover & Co., Ltd., Gas Meter Manufacturers, and R. & A. Main, Ltd., Gas Stove Manufacturers, and Main Water Heaters, Ltd., Water Heating Engineers, in place of the late Mr. Kenneth Aird. Sir Ernest Hiley has acted as Deputy-Chairman since October, 1939.

* * *

Major A. L. S. WOOD has been appointed Managing Director of R. & A. Main, Ltd., and Main Water Heaters, Ltd.

* * *

Mr. W. J. WESTBROOK, Assistant Distribution Superintendent of the Oxford and District Gas Company, has been appointed Distribution Superintendent in succession to the late Mr. F. A. Berry.

Obituary

A link with early pioneering in the gas lighting industry has been broken by the passing of Mr. FREDERICK COE, who was Statutory Inspector of Gas Meters for the City of Nottingham from 1903 until his retirement in 1933. Previously, he had been for many years Lighting Superintendent and Official Inspector of Gas Meters for the Borough of Derby, and it was during this period that his name became associated with the "Coe Anti-Vibrator Unit," which did much to forward the cause of gas lighting in the days before Welsbach produced a mantle that would withstand more than a gentle zephyr. He was the pioneer of the movement which led to the foundation of the Association of Statutory Inspectors of Gas Meters, and was its first Honorary Secretary. His interest and enthusiasm in all matters appertaining to gas meters and the testing of them never flagged, and those who had the privilege of associating with him will mourn his loss.

1941 "Journal" Directory

In order that subscribers may keep the particulars contained in the Directory up-to-date, we summarize below such changes of which we have been advised during the last month.

Page 44. MANNINGTREE. T. Freeman appointed E. & W.M.; and G. Mead, S., *vice* B. Young, retired.
„ 58. RICHMOND (Yorks). W. Hemingway, E. & M., retired.

The Head Offices of the Plymouth and Stonehouse Gas Light & Coke Co. are now situate at 77, Mutley Plain, Plymouth.

It has been decided to hold the 1941 Examinations of The Institution of Gas Engineers in Gas Engineering (Manufacture and Supply) on June 14 and 21 respectively from 10 a.m. to 1 p.m. (Part I), and from 2 p.m. to 5 p.m. (Part II), *and not* from 2 p.m. to 5 p.m. (Part I), and from 6 p.m. to 9 p.m. (Part II) as previously arranged.

A General Meeting of the Illuminating Engineering Society will be held on Tuesday, April 8, at the E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C. 2. The proceedings will be as follows: 2.30 p.m. Addresses will be delivered on (i) "The Measurement or Gauging of Low Values of Illumination and Brightness," by J. W. T. Walsh, M.A., D.Sc., and (ii) "Visibility by White and Coloured Light," by J. S. Dow, B.Sc., and will be followed by a Discussion.

The Accounts of the Alliance and Dublin Consumers' Gas Company for the half-year ended Dec. 31 show a profit on Revenue Account of £69,788. Adding to the net profit the balance of £1,686 brought forward, there is an available balance of £56,356, from which the Directors recommend the payment of a dividend on the consolidated ordinary stock at the rate of 6% per annum, which will leave a balance of £3,333 to be carried to next account. For the same half of the preceding year the dividend was at the rate of 7% per annum, and the carry forward was £6,979. The total quantity of gas sold in the past six months was 6,893,281 therms, which compares with 6,863,858 therms in the same half of 1939.

EXTINGUISHING FLAME AND REPAIRING GASHOLDERS

By LEONARD BOTT

IN 1940 I was on the crown of a four-lift gasholder, the inner lift of which passed upwards out of its guide framing. An unsuspected leakage had become ignited while cleaning operations were going on. The pressure of gas was 9.25 in. The hole through which the gas leaked was equal to a 1-in. gas pipe, but was long and narrow. The first fact that I observed was that no flame was within 6 in. of the sheeting. Bags of sand were on the crown and one of these was dropped on the escaping gas. The result was that the bag burnt away partly and allowed the sand to spread out. Another bag was dropped on the pile of sand; again the bag burnt away and the gas came through the sand and the flame appeared to be unabated. I had called for clay, but was told that none was available. Soil was sent up. This was better than sand, but did not extinguish the flame. For half an hour all attempts to stop the leakage were unavailing. At that point two bucketfuls of sludgy clay arrived on the scene. My assistant took one, and approaching

Hole in a gasholder crown caused by falling debris.

the flame from the windward side deposited the clay over the leakage. It was instantly stopped. The heat had been so intense that the hair of both hands and each side of my assistant's temples was singed. In less than an hour a permanent patch was fitted. An unexpected feature was discovered. The sheeting had been so little heated that the only result was the burning of the paint from its surface.

On two occasions when supervising my men removing a group of leaking patches from the side sheeting preparatory to fitting a single large patch by my own methods, the escaping gas has ignited—usually when hacksawing off the old bolts.

In both cases the flame has been sufficiently far from the side sheets to permit of a wet rag being slid sideways over the escape, so cutting off the flame without its being ignited. On a gasholder being repaired on its side sheeting by electric welding, several leakages ignited and spread over several feet. This was no concern of mine as I had nothing to do with the holder, but the incident is related to describe how this was extinguished. After several attempts of five men to stop the leakages simultaneously without good results, the lift was lowered into the tank water by closing the inlet valve. This space varies with the pressure of the gas. Where there is gas leading to a non-inflammable mixture it provides a simple and sure method of extinguishing an ignited escape.

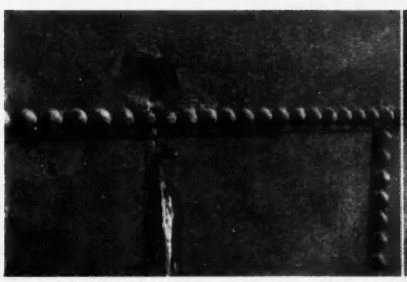
Sand is but little use, because gas gets through it. Further, bags of sand placed on the crown of gasholders 9 to 12 months ago now consist of rotted rags with most of the sand washed into the cup or tank. When inspecting, I frequently find both the remains of the bag and all the sand in the inner lift cup.

During 1941 I have been asked for suggestions by 23 engineers and managers. After the foregoing experience and considerable thought, I am suggesting the following preparations. These include preparedness for large pieces of cast-iron piping or lumps of concrete being hurled on to the crown—both of which I have seen: Have three patches about 14 s.w.g. (if second-hand wrought iron can be obtained it will serve excellently). The largest should be about 26 in. to 30 in. square, the medium one about 18 in. to 20 in. square, and the smallest about 10 in. to 12 in. square. These should be ready drilled with $\frac{3}{8}$-in. holes for $\frac{5}{16}$-in. bolts. Paint them both sides. Place them on the centre of the crown with sufficient bricks or other weights on them to prevent their being disturbed by wind. When necessity calls, secure four light-stranded wires, one to each corner hole, each about 10 to 12 ft. long. When about to cut off the flame, each of four men is given a wire. Two of them drag the patch, with sufficient weights on to prevent the gas pressure from lifting it when over the hole. The two following men guide the patch. It should advance with the wind. Immediately the flame is cut off, or even if it fails to go out, clay is dumped around the edge, commencing at the windward side, until sealed all round. Then the four wires are laid so as to keep the patch in position, weighting the wires with bricks. Immediately make the patch permanent by clearing the clay away on the windward side, sufficiently to permit of putting the first bolt in. It is quite easy to insert some red lead putty between patch and sheet, to ensure tightness. I have rehearsed this procedure at a gas-works in Scotland and all went smoothly and very promising. The reasons I have not advocated fabric for cutting off the flame are as follows: The hole would have to be reopened to get the permanent patch in position. Fabric is not gastight unless specially treated. Fabric is about three times the cost of steel, and steel (or iron) has to be used ultimately.

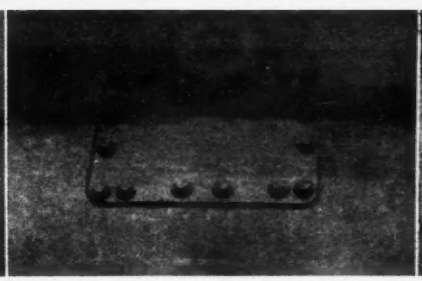
During frosty weather the clay and ropes for hoisting it should be protected near the foot of the ladder. Even in fine weather, if the clay is on top of the holder it is liable to be forgotten and become dry. During the frosty period the rope is liable to become stiff. A line long enough to reach the full height of the gasholder, strong enough to haul up the rope, and convenient to go in a pocket, should be ready to be pocketed and taken to the crown. It is more than probable that this will need carrying through in darkness.

If the gasholder has no ladder, and the standards are not climbable, what is to be done? If the top lift leaves the framing and there is no ladder to the inner lift, one should be fitted, even if only as a temporary measure. Be careful that it will permit the inner lift to land if such is unavoidable. If the gasholder is spirally guided, with ladders attached to the lift sides and with interruptions about 4 ft. at the rail crossings, it is dangerous to climb in daylight, and much more dangerous in the dark.

All ladders, either on guide framed or spiral guided holders,



Shot-hole in gasholder side sheeting.



Permanent patch fitted over puncture in working gasholder.

An awkward patch coveringa 2-in. hole and rafter bar.

should be painted white up their outer edges. Holders without handrailing on the crown will be extremely dangerous at night, especially immediately after the flame is extinguished. The curb cannot be painted white, as this would accentuate the circular shape. Guide framed gasholders could be roped off, using the guide carriages as posts, to which the ropes could be fastened. Spiral holders could have handrail standards secured to the portion of rails projecting above the top curb, and ropes attached to these. It is of vital importance to rehearse whatever method is adopted.

If a flame cannot be put out before the inner lift lands *it must be put out then or an explosion will follow.* Immediately the flame commences to shrink it must be extinguished before a partial vacuum draws air into the lift.

DEVELOPMENT OF A.G.A. REQUIREMENTS*

By W. B. KIRK, A.G.A. Testing Laboratories

FOR more than 15 years the American Gas Association has carried on a continuous programme of research supplementing the preparation and revision of its approval and listing requirements. This work, while an essential part of the Association's testing and certification activities, so far has not received a great amount of recognition and is probably unknown to all but a few of the men in our Industry.

Briefly, the purpose of this type of research is to provide technical data needed by the various sub-committees of the Approval Requirements Committee in developing suitable testing specifications, or in revising existing ones to conform with advancements in the design of appliances and accessories.

It may be stated that without these supplementary studies it would not have been possible for the appliance certification programme of the Gas Industry to develop into the most outstanding and nationally accepted plan of its kind. Accordingly, it seems appropriate to describe at this time the nature of this activity as well as its relation to the movement launched some 15 years ago largely in the consumers' behalf.

Committee Procedure

Before developing the nature and scope of requirements research work, it might be well to consider, briefly, the committee procedure of which this work is an integral part. Up to the present time, approval and listing requirements covering some 40 different types of appliances and accessories have been prepared. In addition, our sub-committees have completed two sets of installation requirements. The preparation of all these standards has been supervised by the A.G.A. Approval Requirements Committee, although their technical development rests largely with the various sub-committees. It may be noted that the Approval Requirements Committee functions as a Sectional Committee of the American Standards Association, and, as a consequence, practically all of these requirements have been adopted as American Standards.

As might be inferred from the large number of different appliances and accessories included in this broad certification field, the problems investigated by the Testing Laboratories annually, in order that the preparation and revision of requirements may be kept apace with developments in the art, vary widely. For example, during the past year research assignments undertaken by the Testing Laboratories covered approximately 35 different problems, varying from the development of complete and new requirements for flexible metal hose to a study of lubricants for gas burner valves to be used on appliances consuming liquefied petroleum gases.

A considerable portion of this investigational work was devoted to problems having for their ultimate objective the expansion or revision of an existing set of requirements. This type of research becomes important when it is considered that in many instances revisions are effected in order that the requirements may not represent a barrier to worth-while and ingenious improvements in appliances or accessories. It has been recognized that unless every precaution is taken, any established standards, regardless of their technical merit, may become restrictive as a result of changing designs. For this reason, the American Gas Association has set up, through its committee structure, a sufficiently flexible administrative procedure to effect, without undue delay, any necessary revisions in its standards, and, in turn, has supplemented this procedure with its research activities.

An example of this type of research may be found in the current year's activities. This case involved the revision of requirements applying to electrical ignition devices which are finding an increasingly widespread use on domestic gas ranges. Heretofore, standards for this type of accessory covered only a specific application of the electrical ignition principle. However, during the year, two other types of electrical igniting devices embodying entirely different principles were developed.

As a result, the Sub-Committee on Approval Requirements for Gas Rangers authorized the Testing Laboratories to conduct research necessary to permit expansion of the requirements to cover, adequately, the new types of ignition systems. This work was promptly undertaken, and a report comprising the technical findings was submitted to the gas range committee at its following meeting. This entire procedure culminated in the adoption of requirements sufficiently broad to cover all types of electrical ignition devices now recognized. This example illustrates clearly the flexibility of the requirements procedure, and the speed with which the necessary revisions can be effected when a need is demonstrated.

Average Performance Rated

A factor which assumes considerable prominence in requirements research work is that the requirements covering performance and constructional features which are not related to safety are minimum ones in the sense that they reflect average performance capabilities, or constructional characteristics of a representative number of appliances or accessories of the type under consideration. Obviously, adoption and enforcement of specifications, aside from those concerned solely with safety which are beyond the ability of a majority of contemporary appliances to meet, could well be considered an untenable and discriminatory procedure.

Adherence to a policy of establishing requirements other than those having safety aspects which are consistent with contemporary performance levels requires that the Testing Laboratories, in the conduct of their research work, investigate a representative group of appliances or accessories involved. This group of appliances must, in each case, be sufficiently large and representative to demonstrate beyond doubt that test methods being developed will be applicable to all types, makes, and modifications of a given class of equipment. Moreover, after the technical soundness and general applicability of the requirement and accompanying test method have been verified by a sufficient number of tests, it is generally necessary to apply the same test to an additional group of appliances or accessories in order to demonstrate that a reasonable percentage of contemporary equipment can comply with the proposed specifications.

Noise Investigation

An outstanding example of this aspect of requirements research work is the comprehensive investigation currently being conducted on noise characteristics of domestic appliances. To date, over 100 different appliances including furnaces, boilers, gas ranges, space heaters, and water heaters have been examined. On completion of this study, there will be reasonable certainty that the requirements adopted by the committees will not only be technically sound and adequate to ensure quiet performance, but will, in addition, not prove to be unduly restrictive.

In many instances requirements research work is of a pioneering nature, and as such it becomes necessary to complete specifications for a given type of appliance or accessory for which standards or test codes did not previously exist. In these cases it is, of course, essential that the investigational work be of a most comprehensive nature. During the present year several problems of this nature have been undertaken. Among these may be mentioned the preparation of requirements for combination coal and gas ranges, flexible metal hose, manual main control valves, and pilot gas valves.

In addition to developing complete sets of new requirements, it is almost always necessary, in adding new sections to existing requirements, to devise original test procedures, and to develop, in many cases, suitable test equipment. An excellent example of this may be found in the study designed to improve the oven heat distribution test currently applied in gas range testing. Under the present specifications, the uniformity of colour of products baked in an oven is judged visually, and this, in some instances, leads to controversy as to differentiation between acceptable and excessive variations. The Testing Laboratories'

* From the *American Gas Association Monthly.*

engineers, after considerable study, developed a photoelectric reflectometer to measure and evaluate accurately colour gradations of baked products.

This is the first application of the photoelectric cell to such instrumentation, and provides a basis for substituting an accurate scientific test method for a rather crude visual observation. Similarly, other studies have been devoted to improving testing methods and instruments, in order that routine test work might be conducted more efficiently, and more accurate and reproducible results obtained.

Another example, illustrating specifically investigations having for their purpose the improvement of existing test procedures, is the study of noise characteristics of domestic appliances, to which reference was previously made. Heretofore, various approval requirements have contained specifications limiting the magnitude of certain noises resulting from extinction of burner flames. Here again, however, the criterion of acceptable performance was the auditory sense, which, as is commonly known, is subject to wide variance with different individuals, as well as to error for any given individual as a result of differences in ambient noise levels. The investigational work now under way makes use of a standard sound-level meter, and it is anticipated that the requirements when finally developed will be set up in terms of standard engineering units.

When it is considered that during the past few years the testing and certification programme has been extended into the field of commercial appliances, accessories, and appliances for use with butane gas, it might be expected that the need for requirements research would tend to decrease as these major problems were completed. However, such has not proved to be the case, primarily for the reason that as the number of appliances and accessories included in the scope of this activity is increased the research needed in maintaining each individual standard on a level consistent with modern developments also increases.

The extent to which it has been necessary to revise requirements in order that they may be kept abreast of appliance development is well demonstrated by the gas range standards. These standards, when published in 1928, contained 165 distinct specifications and covered only the performance of gas ranges on various types of city gases. The latest requirements for ranges, 1940, contain 558 separate requirements covering ranges for use on city gases as well as a large number of additional requirements for propane, butane, and butane-air.

Another phase of the requirements research programme which should be of general interest is a constant endeavour to simplify the requirements, and to replace restrictive constructional specifications by performance tests. As may be readily imagined, any construction requirement has the inherent defect of excluding any but acceptable designs by prohibiting certain specific types or by requiring certain others. On the other hand, a properly devised performance test requires that the structure, as a whole, yield designed performance of an acceptable level without regard to specific constructional details. This aspect of requirements research work is, of course, closely allied with that phase of the work previously discussed, which deals with the development of improved test procedures and test equipment, since, as may be appreciated, construction requirements may exist as a result of a lack of suitable instruments or test methods for determining the characteristics desired.

Naturally, the objective of the previously mentioned programme is to provide the consumer with a safe appliance capable of performing in an acceptable manner the various tasks for which it was designed. It is an equally important function of this programme to accomplish this purpose without undue burden on the Industry, and without setting up standards which would in any way restrict the application of ingenuity on the part of manufacturers in their efforts to improve their products. These objectives have been achieved largely through the effects of our various requirements committees. However, requirements research activities have, in providing technical data required by these committees, been a contributing factor in the success of the entire programme.

RECOVERY OF BENZOLE FROM CARBURETTED WATER GAS

By BERNARD RICHARDSON, *Newcastle-upon-Tyne and Gateshead Gas Company*

DETAILED information as to the nature, chemical composition, and quantity of the light spirit present in carburetted water gas has hitherto been very scanty. Reference is, however, made to it by Voss (*J. S. C. Ind.*, 1927, Abstract), who states that benzole absorbed from carburetted water gas by means of active charcoal contained 0.73% paraffins, 12% unsaturated hydrocarbons and 32.4% toluene. This authority further adds that with adequate washing a satisfactory benzole could be obtained.

With a view to supplementing this contribution to the subject the writer has recently extracted several samples of light spirit from carburetted water gas and examined these in some detail. The water gas upon which the tests were conducted possessed a calorific value of from 400 to 450 B.Th.U. per cu.ft., and in order to produce this quality it was necessary to employ from 1.2 to 1.5 gallons of carburetting oil per 1,000 cu.ft. of blue gas made.

A representative sample of the oil showed it to contain the following constituents, expressed as percentages by volume:

1. Paraffins	62.4%
2. Unsaturated hydrocarbons	10.0%
3. Aromatic „	18.9%
4. Naphthenes	8.7%
"Open chain" hydrocarbons (1 + 2) — 72.4%	

It was "cracked" in the carburettor at a temperature of 750°C. and about 86% appeared to be converted into permanent hydrocarbon gases and light spirit, while 14% was recovered as tar, consisting in the main of aromatic bodies and over 17% by weight of naphthalene.

The light spirit was washed out of the gas by means of gas oil pre-distilled to a temperature of 260° C. It was then isolated by dry distillation of the benzolized oil to 280°C., and after separation of water and drying over fused calcium chloride the distillate was finally taken up to 180°C. in an 8-bulb fractionating column. The volume of oil collected at this temperature was taken as representing the spirit which had been washed from the water gas, and it was found that 1.3 gallons could be obtained per 12,000 cu.ft. treated. Thus, from 9% to 10% of the oil employed in the carburettor had apparently been converted into hydrocarbons boiling below 200°C.

Water gas, carburetted to 360 B.Th.U., was also examined as to benzole yield, and in this case just over 0.5 gallon of oil per 12,000 cu.ft. was obtained. It may, however, be noted that as regards chemical composition there was little difference between it and the benzole derived from 450 B.Th.U gas.

The spirit recovered in all cases possessed a bright canary-yellow tinge, and two analyses are given in the accompanying table. Sample A was obtained from an H. & G. automatic set, and sample B represents benzole from a mixture of gas produced in both automatic and hand-operated "single superheater" units. The calorific value of the gas in each instance averaged 415 B.Th.U., and in each instance also the sample gave 95% over at 160°C. when distilled through an 8-bulb fractionating column at the rate of two drops per second.

TABLE I.—COMPOSITION OF BENZOLE FROM CARBURETTED WATER GAS.

	A.	B.
Spec. Grav. @ 15.5°C.	0.855	0.859
Carbon disulphide	0.02	0.01
Benzene	30.36	20.59
Toluene	22.30	23.10
Xylenes (to 140°C.)	3.60	7.60
Paraffins (to 140°C.)	5.40	2.20
Distillate 140–180°C.	6.32	12.50
Loss in acid washing:		
(*a*) Olefines	13.00	16.70
(*b*) Polymerized compounds soluble in benzole	19.00	17.30
Spec. Grav. of fraction 0–140°C. after rectification...	—	0.867

The most striking features of this spirit may be summarized under the following headings:

1. The relatively high toluene and low benzene content.
2. The small proportion of carbon disulphide present.
3. The reasonably small proportion of paraffins, the figures in both cases being as low as those found in many samples of benzole derived from horizontal retort gas.
4. The considerable volumes of unsaturated hydrocarbons in the spirit.

Regarding the last point it may be noted that washing the spirit for five minutes with 8% by volume of 95% sulphuric acid, followed by water, caustic soda solution, and water again, resulted in a volume decrease of 13% and 16.7% in the case of A and B respectively.

This contraction is often stated to represent the olefines, but basic constituents, such as pyridine, aniline, &c., may also be removed, although it seems doubtful whether these constituents are present in any but the smallest traces in water gas benzole.

The sulphuric acid, however, causes polymerization of other unsaturated hydrocarbons, such as the dienes, to take place. This results in the formation of high-boiling-point bodies which remain dissolved in the benzole after washing. An indication of the volume of these substances is obtained by measuring the quantity of oil left above 180°C., when the washed spirit is refractionated. In the case of the carburetted water-gas benzoles cited above more than half the total acid-washing loss of 32% was due to the formation of such bodies, which remain as dark-brown resinous residues in the distillation flask. In any large scale industrial process they would, of course, be lost in the " still bottoms."

The initial low specific gravity of the benzoles was due in the main to these unsaturated bodies, for after their elimination it increased to an almost normal figure.

The relatively high toluene content in the water gas spirit bears out the figures given by Voss, and for the sake of this constituent it would seem highly desirable during a state of national emergency to wash, wherever possible, the benzole from carburetted water gas as well as from the coal gas.

In the opinion of the writer benzole extraction will not add to the cost of the process unless the price of gas oil is 8d. per gallon or over. To illustrate this statement let us consider the net cost of manufacturing, say, 10 million cu.ft. of water gas, carburetted to a calorific value of 457 B.Th.U., when the price of gas oil is first 6.45d. and then 8d. per gall., while the coke consumed is charged to the plant in both cases at the rate of 27s. 6d. per ton.

The total net price per therm under these conditions is itemized in the accompanying table. In column (1) the gas oil is assumed to cost 6.45d. per gallon and in column (2) 8d. per gallon.

	(1) Pence per therm.	(2) Pence per therm.
Coke to generator	1.52	1.52
Oil for carburetting (19,800 galls.)	2.79	3.47
Labour	0.29	0.29
Plant repairs	0.05	0.05
Steam, water, and electricity ...	0.37	0.37
Purification	0.04	0.04
	5.06	5.74
Less—		
Receipts from sale of water gas tar at 2d. per gallon	0.11	0.11
Net cost of water gas	4.95	5.63

If, however, the carburetted water gas is to be washed for benzole after its admixture with coal gas, it will be necessary to make a larger volume of somewhat richer quality in order to compensate for the losses which take place under both heads as the result of extracting benzole hydrocarbons. Therefore, instead of 10 million cu.ft. of 457 B.Th.U. gas, 10,049,000 cu.ft. possessing a calorific value of 467 B.Th.U. must be manufactured, which will entail an extra amount of carburetting oil—*i.e.*, 21,200 gall. instead of 19,800 gall. Such a gas at 85% extraction efficiency should yield about 870 gallons of benzole, and its net cost of production with gas oil priced at 6.45d. per gallon and 8d. per gallon would accordingly be of the following order:

	(1) Oil at 6.45d. per therm.	(2) Oil at 8d. per therm.
Coke to generators	1.46	1.46
Oil for carburetting (21,200 galls.)	2.91	3.61
Labour, steam, water, electricity, purification, &c.	0.75	0.75
Cost of benzole recovery	0.06	0.06
	5.18	5.88
Less—		
Receipts from sale of water gas tar at 2d. per gallon	0.14	0.14
Receipts from sale of benzole ...	0.21	0.21
Net cost of water gas	4.83	5.53

With oil at the lower figure of 6.45d. per gallon the total net cost of manufacturing 10 million cu.ft. without benzole recovery is:

$$\frac{457 \times 10{,}000{,}000 \times 4.95}{240 \times 100{,}000} = £942.$$

When benzole is extracted, the figures become:

$$\frac{467 \times 10{,}000{,}000 \times 4.83}{240 \times 100{,}000} = £939.$$

If the carburetting oil is charged at the rate of 8d. per gallon the costs of manufacturing 10 million cu.ft. of gas are increased to—

(*a*) £1,072 without benzole recovery.
(*b*) £1,076 with benzole recovery.

There is, therefore, a slight, but definite, saving when benzole recovery is practised in conjunction with gas oil at just under 6½d. per gallon, and a similar slight, but definite, loss when the price is raised to 8d.

The writer's experience is that it is justifiable to take credit for the water gas tar at 2d. per gallon, since he had found it to consist on the average of the following constituents by weight:

Naphthalene	17%
Other aromatic hydrocarbons	39%
Unsaturated hydrocarbons	16%
Paraffins	4%
Naphthenes	1%
Pitch	23%

Such a product should prove of considerable value to the tar distiller and a proportion could, with advantage, be added to coal tar without detriment to the latter. It may be mentioned that in the case of one undertaking the whole of the water gas tar is, after dehydration, sold at a price of just under 5d. per gallon, so that the valuation figure of 2d. would appear to err considerably on the side of moderation.

The figure given in the balance sheet for the cost of benzole extraction—*i.e.*, 0.06d. per therm of gas made—may at first sight appear unduly low, but it is felt that it would be unfair to charge the full cost of recovery to the water gas process because in the vast majority of cases the existing benzole plant is able to deal with the additional water gas spirit without incurring extra capital, labour, or maintenance charges, and with a very small increase in steam consumption.

In consequence the cost of recovery expressed as pence per gallon tends to fall and if, for example, a daily make of 500 gallons of coal gas benzole costing 6d. per gallon were augmented, by washing carburetted water gas, to 630 gallons costing only 5½d. per gallon, then it would be illogical to charge the extra 130 gallons at 6d. Obviously they have cost considerably less than this figure.

Where carburetted water gas is manufactured as an auxiliary to coal gas during the winter months only, then the price of the carburetting oil may, with advantage, be reduced considerably below 8d. per gallon by employing a mixture of spent gas oil from the benzole plant and fresh oil. Moreover, the so-called "naphtha residues" obtained from the benzole plant may also be passed on to the water gas plant, as over 75% consists of the lower boiling point fractions of the gas oil. It has been found that the residues from one benzole plant contained over 66% "open chain" hydrocarbons and gave very successful results when used for carburetting purposes, although the thermal yield of gas per gallon was somewhat lower than that obtained from fresh gas oil.

The total sulphur content of purified carburetted water gas, having a calorific value of from 400/450 B.Th.U., usually varies between 7 and 8 grains per 100 cu.ft. Conditions obtaining in the carburettor are such that the bulk of the sulphur in the oil is converted into sulphuretted hydrogen and only a very small proportion into carbon disulphide. Thus, the carbon disulphide content of benzole derived from a mixture of coal gas and carburetted water gas has always been found less than that obtained by washing coal gas alone.

The following table shows the variations in composition existing in the benzole produced from coal gas generated in horizontal retorts and the spirit obtained from a mixture of 56% by volume of coal gas and 44% by volume of water gas, the calorific value of the latter being 430 B.Th.U. prior to benzole extraction:

	Coal gas benzole, Horizontal retorts.	Benzole from mixture of 56% coal gas and 44% C.W. gas.
	(*a*)	(*b*)
Spec. Grav. @ 15.5°C.	0.874	0.868
Carbon disulphide	0.6%	0.5%
Benzene	63.2%	46.1%
Toluene	11.5%	15.2%
Xylenes (to 140°C.)	3.0%	2.8%
Paraffins (to 140°C.)	3.6%	3.0%
Total loss in washing	13.2%	25.2%
Distillate 140°C.–160°C.	2.4%	2.0%
" 160°C.–180°C.	0.8%	2.4%
Wash oil	1.7%	2.8%
Evaluation test (% @ 160°C.) ...	92.0%	94.0%

By washing this mixture the yield of crude benzole, expressed as gallons per ton of coal carbonized, increased by nearly one gallon—namely, from 2.4 gallons to 3.3 gallons—showing that an extra gallon of benzole per 12,000 cu.ft. had been derived from the carburetted water gas.

Finally, the writer would state that his personal views and conclusions only are expressed in this communication. They do not necessarily represent those of the undertaking with which he is associated.

WASTE HEAT RECOVERY IN CARBONIZING PRACTICE*

By HAROLD BUCKLEY

THE first duty of a fuel technologist—and every gas engineer should consider himself a fuel technologist—is to conserve the national resources of the country by using less raw material for his operations. This is realized more than ever in wartime and periods of industrial depression, but it is none the less important in peacetime and boom periods.

Of recent years, chiefly since the introduction of the continuous vertical retort, considerable strides have been made in the overall thermal efficiency of carbonizing practice. It is the intention of this Paper to consider what has been done and what may still be done to further the efficiency of carbonizing plants and so conserve the nation's most precious mineral—coal.

The four main types of plants used for carbonizing in this country are: (*a*) Horizontal retorts (modern plants are invariably "through" retorts and may be fitted with either internal or external producers); (*b*) continuous vertical retorts; (*c*) intermittent vertical retorts; and (*d*) coke ovens.

Each has its own particular advantages and suitability for certain circumstances, and it is inaccurate to say that one type is better than another. While these four types of plants vary greatly in the manner in which they treat the coal, it can be shown that if the plant is well controlled and waste heat recovery wisely and fully practised, there is very little difference between the thermal efficiencies of the various types of plants, and their particular usefulness for any works depends on such factors as ground space available, the desired calorific value of the gas, the flexibility required, and the quality and type of coke desired.

The waste heat in carbonizing practice may be divided into three main classes:

(*a*) The heat in the "waste gas," the products of combustion leaving the setting.

(*b*) The heat in the coke as discharged from the retort.

(*c*) Other losses, such as heat in the gas leaving the retorts.

A portion of the heat from (*a*) may be recovered in recuperators or regenerators to preheat the primary or secondary air. Recuperation is the recovery of the heat in the products of combustion from the combustion chambers after the gas has done its useful work in heating the setting and carbonizing the coal.

The heat recovery usually takes the form of preheating the secondary air required for the combustion of the producer gas by passing the outgoing gases and incoming air along adjacent flues. Regeneration as practised on coke ovens consists of first passing the "waste gas" through a specially designed brick-filled chamber, while the ingoing air passes through another exactly similar chamber. After a predetermined period of time, depending on the design and capacity of the regenerators and the even heating of the ovens, the flow is reversed so that the air is taken through the chamber which has been heated by the outgoing waste gases. In passing through the regenerator the air takes up sufficient heat from the brickwork to ensure a satisfactory reaction between the producer gas (or coal gas) and the air.

Design of Recuperators

The main points to be noted in the design of recuperators and regenerators are:

(1) The temperature of the secondary air can only be raised to the temperature of the outgoing "waste gases" irrespective of the total quantity of heat in them.

(2) The amount of heat transferred from the products of combustion to the secondary air varies with the thickness of the wall, the conductivity of the refractory used, and the surface area of the flue—this latter being determined by (3).

(3) The largest perimeter for conduction is given by a rectangle; the longer and narrower the greater will be the perimeter. In practice, however, the waste gas flues must be wide enough to allow of easy access for cleaning while working.

A further point to note is that the secondary air flues should only receive heat from the waste gas and not from the producer. Some makers still persist in sandwiching a secondary air flue between the producer wall and a waste gas flue with a consequent loss in producer efficiency. Recuperators are usually used with horizontal and intermittent vertical plants and occasionally on a continuous vertical installation. Frequently, recuperation alone is practised and the waste gases pass straight up the chimney after preheating the secondary air.

Considering the heat in the "waste gases" it has been found from a number of heat balance charts that with horizontal and intermittent vertical plants the heat available for recovery, after allowing for the heat to the stack, will be in the region of 18% to 23% of the total heat in the coke used on the producers, and with continuous vertical retorts this figure will be from 33% to 35%. The great difference between the heat available in the waste gases in static and continuous practice is accounted for by the fact that with continuous verticals the heat of the coke is used again in the carbonizing process. If the available heat in the hot coke as discharged were to be reckoned together with the available heat in the waste gases, the figure for static carbonization would rise from 20% to between 28% and 32% of the total heat in the coke to the producers, so becoming comparable with continuous carbonizing practice.

It is recognized practice with continuous vertical plants to recover the waste heat in a waste heat boiler—even if recuperation is practised. Far too many works, however, with horizontal retorts, and even some with intermittent vertical retorts, still do not use a waste heat boiler, the argument being that there is "a black flue at the outlet of the regenerators (or recuperators) and so recovery is useless."

In order to show that waste heat recovery is possible for small and medium-sized works using full recuperation, it will be well to calculate from typical figures the heat required to preheat the secondary air up to the temperature of the waste gas leaving the setting. Taking a producer gas of the following composition: CO_2 7.5%; CO 26%; H_2 12%; N_2 54.5%:

	Vol. cu.ft.	O_2 required. cu.ft.	Products of combustion.		
			CO_2.	H_2O.	N_2.
CO_2	0.075	—	0.075	—	—
H_2	0.12	0.06	—	0.12	0.22
CO	0.26	0.13	0.26	—	0.49
N_2	0.545	—	—	—	0.545
		0.19	0.335	0.12	1.255

Every cu.ft. of producer gas required 0.19 cu.ft. of oxygen, and allowing 50% excess oxygen becomes 0.285 cu.ft. of oxygen or 1.071 cu.ft. of air.

The value of the products of combustion is 1.71 cu.ft., which with the air taken in to provide excess oxygen becomes 2.02 cu.ft.

The temperature of the waste gases leaving the setting will be between 1,000° and 1,200°C., and these are met by about half their volume of incoming air. With 100% efficiency in the recuperators and neglecting for the moment the difference in the specific heat of the waste gas and air, it is evident that the incoming air can only absorb about half the heat in the waste gases. Some heat will, of course, be lost to the chimney, but there is a considerable and useful margin between the heat content of the products of combustion and the heat used for recuperation and creating "pull" if natural draught is used.

It is apparent, therefore, that even if recuperation is practised to its fullest extent there should still be heat in the waste gases available for steam raising, and the black flue found in so many works and often taken as proof of efficient working must be recognized as due to inefficient working somewhere. Most probably, if the gases were analyzed, they would be found to have a very great excess oxygen, caused by the infiltration of air into the recuperators through badly fitting inspection doors, cracks in the internal walling of the recuperators, porous brickwork, or too great chimney pull.

In order to find how much steam it is possible to generate, the graphs in figs. 1 and 2 have been made, and are based on the following assumption:

The producer gas has the composition previously given, the plant uses 14 lb. of coke per 100 lb. of coal carbonized, the percentage of carbon gasified on the weight of dry coke is 90%.

In fig. 1 the gases leave the boiler at 450°C.

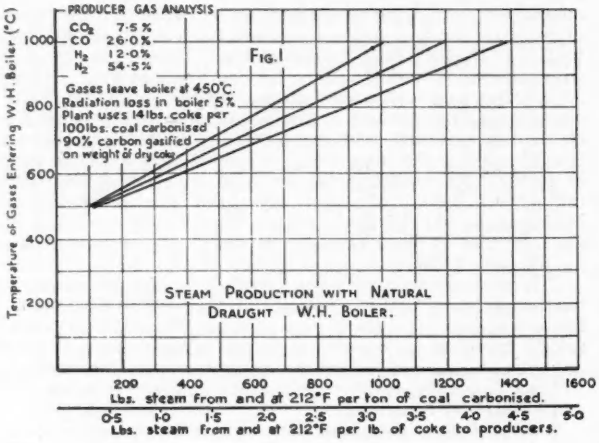
In fig. 2 the gases leave the boiler at 230°C., and an

* This Paper was among those submitted for the Student Medal Competition of the Institute of Fuel last September, and was awarded a special premium by the Council. We reprint it from the February issue of the *Journal* of the Institute of Fuel.

induced draught fan will be necessary as the temperature of the waste gases will be too low to set up the necessary aeromotive force to give the required pull to the setting.

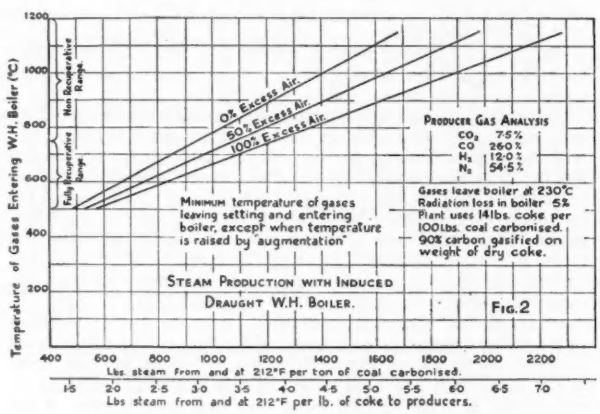
In both graphs an allowance of 5% of the total heat to the boiler is made to cover radiation losses from the boiler, but no account is taken of the heat in the blow-down water, as this varies considerably on different works depending on the quality of the feed water.

It will be seen from the graph (fig. 2) that a carbonizing plant working under reasonably fair conditions (gas temperature after


PRODUCER GAS ANALYSIS
CO_2 7·5%
CO 26·0%
H_2 12·0%
N_2 54·5%
FIG. 1
Gases leave boiler at 450°C.
Radiation loss in boiler 5%
Plant uses 14 lbs. coke per 100 lbs. coal carbonised
90% carbon gasified on weight of dry coke
STEAM PRODUCTION WITH NATURAL DRAUGHT W.H. BOILER.
Temperature of Gases Entering W.H. Boiler (°C)
1000
800
600
400
200
200 400 600 800 1000 1200 1400 1600
Lbs. steam from and at 212°F per ton of coal carbonised.
0·5 1·0 1·5 2·0 2·5 3·0 3·5 4·0 4·5 5·0
Lbs. steam from and at 212°F per lb. of coke to producers.

recuperation and entering boiler 600°C., 50% excess air) can produce 750 lb. of steam from and at 212°F., per ton of coal carbonized, and if the minimum economic size of induced draught waste heat boiler is one evaporating 1,500 lb. per hour, a works carbonizing about 2 tons per hour, or 48 tons per day, should find it advantageous to use a waste heat boiler after full recuperation.

The fan will require between 10% and 20% of the total steam produced, the steam required becoming less as the size of the boiler increases. Taking the steam requirements of the fan as 15% of the total steam produced and a plant carbonizing 2 tons per hour, under the previous conditions there would be available for use 1,350 lb. of steam per hour, which would supply between 30% and 50% of the total steam required for the works (taking the steam required on the works as between 900 lb. and 1,500 lb. of steam per ton of coal carbonized).


Temperature of Gases Entering W.H. Boiler (°C)
1200
1000
800
600
400
200
Non-Recuperative Range
Fully Recuperative Range
0% Excess Air.
50% Excess Air.
100% Excess Air.
PRODUCER GAS ANALYSIS
CO_2 7·5%
CO 26·0%
H_2 12·0%
N_2 54·5%
Minimum temperature of gases leaving setting and entering boiler, except when temperature is raised by "augmentation"
Gases leave boiler at 230°C
Radiation loss in boiler 5%
Plant uses 14 lbs. coke per 100 lbs. coal carbonised.
90% carbon gasified on weight of dry coke.
STEAM PRODUCTION WITH INDUCED DRAUGHT W.H. BOILER.
FIG. 2
400 600 800 1000 1200 1400 1600 1800 2000 2200
Lbs. steam from and at 212°F per ton of coal carbonised.
1·5 2·0 2·5 3·0 3·5 4·0 4·5 5·0 5·5 6·0 6·5 7·0
Lbs steam from and at 212°F per lb. of coke to producers.

Owing to the high steam requirements and upkeep costs of the turbines, works carbonizing less than about 40 tons per day will probably find it advisable to use a natural draught waste heat boiler. The minimum economic size of natural draught waste heat boiler is one evaporating 600 lb. per hour, but with this type of boiler the yield of steam per ton of coal carbonized is naturally much less, owing to the gases having to enter the chimney at a temperature sufficiently high to give the required "pull" to the setting.

From the graph (fig. 1) it will be seen that with the gases entering a natural draught waste heat boiler at 850°C., and with 50% excess air, there will be produced some 900 lb. of steam per ton of coal carbonized, so that an installation carbonizing 16 tons per day in a non-cuperative setting should find it profitable to use a natural draught waste heat boiler. The figure of 16 tons per day carbonized is a minimum, and if during the slack period this figure is not reached it will be necessary to resort to augmentation.

With recuperative or semi-recuperative settings the steam deficiency is usually supplied by direct-fired Lancashire or Cornish boilers, but on some modern installations this deficiency has been made up by augmenting the waste gases by the combustion of producer gas in the waste gas flue to the boiler, the excess oxygen of the waste gases being used either in full, or partially, to supply the necessary oxygen for the combustion of the producer gas.

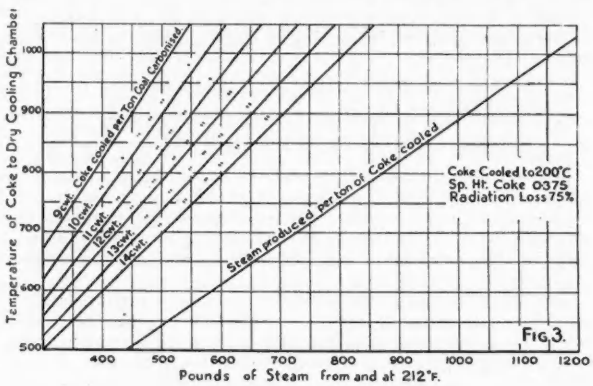
The advantages of this system are worthy of note:

(*a*) There is a reduction in labour costs.

(*b*) Fire tube boilers being more flexible than Lancashire boilers, the steam supply is readily varied to suit the fluctuating load of the works—the daytime load is considerably in excess of the night load, due to working such extra plant as coke breakers, coal elevator, and the shops.

(*c*) Now that breeze-burning is a working proposition in producers, the production of steam from producer gas gives an outlet for low-grade fuel without the expense of installing special feeders to direct fired boilers in order to use it.

It is possible on almost any plant to arrange a flue from the producer to the waste heat boiler necking to augment the "waste gases" without great expense; providing the boiler is of sufficient capacity, this is worthy of consideration at the present time. It has, however, been found necessary where the temperature of the waste gases to the boiler is as high as 900°C.,



to re-circulate a proportion of the waste gases from the induced draught fan back to where the combustion of the producer gas takes place.

Probably the most serious loss of sensible heat in carbonizing practice to-day is the loss of sensible heat in the coke as discharged. Not only is this heat lost, but much money is wasted on water for quenching; much dust and dirt is blown skywards to pollute the atmosphere.

Advantages to be gained by dry cooling are:

(*a*) Cheap steam.

(*b*) A perfectly dry, easily ignitable coke of excellent appearance having less friability is produced.

(*c*) Considerably less breeze is formed, as the coke has greater mechanical strength and has not been subjected to the stresses set up by water-cooling.

(*d*) There will be less corrosion of the steelwork in the retort house, and the building will be much easier to keep clean.

The heat in the coke will be in the region of 20% to 25% o the total heat in the coke to the producers in horizontal and intermittent vertical practice, depending with intermittent vertical retorts on the percentage of steaming. With coke ovens this figure is as high as 30% or 35%, while with continuous vertical retorts the coke as discharged is too cool for heat recovery, containing some 5% of the heat in the coke to the producers.

It is seen from the foregoing that the loss of sensible heat in the coke is most serious in coke oven practice, and as coke ovens are primarily plants for the production of a hard, metallurgical coke, most readily obtained by dry cooling, it is in this field that dry cooling should be most readily adopted. There are a few coke oven plants practising dry cooling in England, but they

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are more common on the Continent. Dry cooling plants, however, are readily made for any of the three types of carbonizing plants with sensible heat in the coke worth recovering.

In general, the principle employed is simply the circulating of the hot, inert gases from the coke in a closed circuit containing a fire tube boiler which extracts the heat from the gases transmitting it to the water. The air which is taken in with the charge is rapidly converted to CO and CO_2, the percentage of each depending on the temperature at that particular time. Circulation is accomplished by a fan and the rate of evaporation can be varied by increasing or decreasing the speed of the fan; this, of course, also varies the rate of cooling. The temperature of the gases varies with the quantity and temperature of coke charged to the chamber.

Plants are made in almost any size from the smallest economical unit of 12 tons of coke per day to multiple installations capable of cooling the coke from the largest of carbonizing plants.

In order to be able to obtain an idea of the total possible amount of steam which can be produced by dry cooling, a graph has been computed (fig. 3) giving the weight of steam from and at 212°F., per ton of coke cooled and per ton of coal carbonized. Tables giving the exact specific heat of coke at various temperatures are not available, so the specific heat of the coke has been taken as 0.375, being an average figure from various continental authorities.

Of the remaining waste heat, the only calculable loss is the sensible heat in the coal gas and liquor leaving the setting. This figure is very small, in the case of the three main types of plants used on gas-works being between 2% and 5% of the total heat in the coke to the producers. In coke oven practice the loss from this source is greater, being in the region of 12% of the total heat in the coke to the producers (or 12% of the heat in the gas used to heat the setting). Some of this heat may be recovered by using the cooling water from the condensers as boiler feed water. Before attempting to do this, however, it must be considered if the water is pure enough; and whether it will be a practicable possibility or not will depend largely on the layout of the works. With coke ovens, although the heat content of the gases is high the hydraulic main and foul main are usually of great length and in exposed positions, so that there is very little sensible heat left when the water condensers (if used) are reached.

Summary

From the accompanying graphs it will be seen that a works employing horizontal retorts and working as follows :

For maximum recuperation and waste heat recovery the waste gases enter the boiler at 600°C., and contain 50% excess air. The coke is discharged to the cooling chambers at 950°C., and 12 cwt. is cooled per ton of coal carbonized. The total steam produced per ton of coal carbonized will be approximately 1,390 lb. from and at 212°F.

With intermittent verticals under the same conditions, except that 11 cwt. of coke is cooled per ton of coal carbonized, the steam production will be approximately 1,350 lb. from and at 212°F. per ton of coal carbonized. In the case of a continuous vertical plant the steam produced will be 1,650 lb. from and at 212°F. if the waste gas contains 50% excess air and enters the boiler at 1,000°C.

It has been stated previously that with continuous vertical retorts it should be possible to supply the whole of the steam requirements of the works, and it can now be seen that with dry cooling and waste heat recovery after full recuperation in horizontal and intermittent vertical practice, it is possible to produce between 900 lb. and 1,500 lb. from and at 212°F. per ton of coal carbonized. This is equivalent to between 750 lb. and 1,250 lb. at 100 lb. per sq. in. pressure, which will supply between 50% and 80% of the total works requirements.

At a Recent Meeting of the Directors of the Colonial Gas Association, interim dividends were declared for the half-year ended Dec. 31 last, at the rate of 4% less income-tax, on the Preference Shares, and at the rate of 3% less income-tax, on the Ordinary Shares. Exchange will be deducted from these dividends at the rate ruling on the date the dividend was declared—viz., £100 in London for £125 10s. in Melbourne. The dividends due to shareholders on the London Register will be payable in London on April 4 next, but where instructions to that effect have already been given to the Association, the dividends due to such shareholders will be paid in Australia to a Bank there on their behalf, or to an accredited Agent. It is not necessary to renew these instructions, the dividend being paid in accordance with such instructions until further notice is given by such shareholders.

Association of Tar Distillers

The following were appointed at the Annual General Meeting on March 18 to serve as the Officers and Executive Committee of the Association for the ensuing year: President, Col. W. A. Bristow; Vice-President, Mr. C. E. Carey; Honorary Treasurer, Mr. C. E. Carey; Honorary Auditor, Mr. E. Hardman. Executive Committee: British Tar Products, Ltd.; Brotherton & Co., Ltd.; Burt, Boulton & Haywood, Ltd.; Wm. Butler & Co. (Bristol), Ltd.; The Consett Iron Co., Ltd.; Crow, Catchpole & Co., Ltd.; Arthur J. Dickinson, Ltd.; Dorman, Long & Co., Ltd.; The Gas Light & Coke Company; Glasgow Corporation Chemical Works Dept.; E. Hardman, Son & Co., Ltd.; Hardman & Holden, Ltd.; Lancashire Tar Distillers, Ltd.; City of Leicester Gas Department; Lennard & Co. (Shoreham-by-Sea), Ltd.; Low Temperature Carbonization, Ltd.; Midland Tar Distillers, Ltd.; Monsanto Chemicals, Ltd.; Thomas Ness, Ltd.; Newcastle-upon-Tyne & Gateshead Gas Company; Normanby Park Tar Supply Co., Ltd.; North-Western Co-operative Tar Distillers, Ltd.; Powell Duffryn Associated Collieries, Ltd.; Rothervale Collieries Branch, United Steel Cos., Ltd.; Sadler & Co., Ltd.; Scottish Tar Distillers, Ltd.; Simon-Carves, Ltd.; South Bank Chemical Co., Ltd.; South-Eastern Tar Distillers, Ltd.; South Metropolitan Gas Company; South Wales Tar Distillers; South-Western Tar Distilleries; South Yorkshire Chemical Works, Ltd.; Staffordshire Chemical Co. (1917), Ltd.; Staveley Coal & Iron Co., Ltd.; Tar Distillers, Ltd.; Thorncliffe Coal Distillation, Ltd.; Yorkshire Tar Distillers, Ltd.; Mr. W. J. U. Woolcock.

The Acting Secretary of the Association is Mr. R. Murdin Drake, O.B.E., M.Sc., the Assistant Manager of the Association of British Chemical Manufacturers.

Control of Coal Tar Order, 1941

The Secretary for Mines has issued Directions in respect of anthracene and phenol which will come into operation on April 14. The effect of the Directions is as follows:

Anthracene

1. In pursuance of paragraph 3 of the Control of Coal Tar Order, 1941, no "Distiller" or "Importer" (for definition see paragraph 11, S.R. & O. 1941, Number 81, Control of Coal Tar Order, 1941, dated Jan. 20) may dispose of coal tar distillates or products separated therefrom, containing anthracene in quantities amounting to 15% or more, except under the authority of a licence.

2. In pursuance of sub-paragraph 1 of paragraph 8 of the Control of Coal Tar Order, 1941, no person may dispose of crude anthracene "A" quality containing 40% or more of anthracene except at the price of 8d. per unit delivered at consumer's works, and no person may dispose of anthracene paste containing 15% of anthracene and less than 40% of anthracene except at the price fixed in the following schedule:

Percentage of anthracene contained in the anthracene paste.	Price per ton f.o.r. at producer's works. £ s. d.
15% and less than 16% (with an increase of 6s. per ton for every 1% of anthracene, up to and including 25% anthracene).	8 0 0
26% and less than 27% (with an increase of 8s. per ton for every 1% of anthracene, up to and including 30% anthracene).	11 8 0
31% and less than 32% (with an increase of 10s. per ton for every 1% of anthracene, up to and including 35% anthracene).	13 10 0
36% and less than 37% (with an increase of £2 per ton for every 1% of anthracene, up to and including 39% anthracene).	17 0 0

For the purpose of these Directions, the quantity of anthracene in the product is to be determined by the Anthraquinone Test as laid down in the 1938 edition of *Standard Methods of Testing Tar and its Products.*

Phenol

In pursuance of paragraph 3 of the Order above referred to, no distiller or importer may dispose of phenol or phenol mixtures, except under the authority of a licence. Phenol and phenol mixtures for the purpose of this Direction shall be defined as follows:

Phenol.—Carbolic acid derived from any source and having a melting-point within the range 39°C. to 41°C. inclusive as determined by the method defined in the 1938 edition of *Standard Methods of Testing Tar and its Products.*

Phenol Mixtures.—Mixtures of phenol with any diluent and containing not less than 80% by weight of phenol as determined by the method defined in the 1938 edition of *Standard Methods of Testing Tar and its Products.*

The General Committee of the National Federation of Gas Coke Associations will hold a meeting on April 8, at Gas Industry House, S.W. 1, at 10.45 a.m.

Gas Products Prices

The London Market

Mar. 31.

Current prices of Tar Products in the London Market are as follows: Pitch is nominal; creosote 4¾d. to 5d. per gallon; refined tar 3¾d. to 4d.; pure toluene under the Ministry of Supply Toluene No. 2 Order is 2s. 5d.; pure benzole is 1s. 10d.; 95/160 solvent naphtha is 2s. 3d. to 2s. 6d.; and 90/160 pyridine about 13s. 6d.; all per gallon naked; refined crystal naphthalene £23 per ton in bags; all *ex* Makers' Works.

The Provinces

Mar. 31.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 1s. 10d. (controlled by the Control of Toluene No. 2 Order, July 5, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North, 10d. to 11d. Solvent naphtha, naked, North, 1s. 9d. to 1s. 10d. Heavy naphtha North, 1s. 6d. to 1s. 7½d. Creosote, *ex* works, in bulk, North, liquid and salty, 4½d. to 4¾d.; Scotland, 4½d. to 4¾d.; low gravity, 4½d. to 4¾d. Fuel Grade, 4d. to 4¼d. Carbolic acid, 60's, 3s. 7½d. to 3s. 9d. Naphthalene, £12 to £15. Salts, 70s. to 80s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil (min. gr. 1,080), 5¼d. to 5½d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note in our issue of Sept. 4, 1940, p. 404.

Tar Products in Scotland

GLASGOW, March 29.

Most products continue in steady call and the demand for Tar Acids is sustained.

Refined tar is in slightly better call in the home market at 4¼d. to 4¾d. per gallon, while for export value is maintained at 3¼d. to 3½d. per gallon, both f.o.r. naked.

Creosote oil is well looked after at the following prices: Specification oil, 5d. to 5¼d. per gallon; low gravity, 6d. to 6¼d. per gallon; neutral oil, 5¾d. to 6d. per gallon; all *ex* Works in bulk.

Cresylic acid: The improvement noted last week continues with prices firmer as under: Pale, 99/100%, 2s. 3d. to 2s. 5d. per gallon; Pale, 97/99%, 2s. 2d. to 2s. 4d. per gallon; Dark, 97/99%, 1s. 10d. to 2s. per gallon; all *ex* Works in buyers' packages.

Crude naphtha shows no change at round 6½d. to 7½d. per gallon *ex* Works in bulk, according to quality.

Solvent naphtha: 90/160 grade is 1s. 8½d. to 1s. 9d. per gallon and 90/190 Heavy Naphtha is 1s. 4½d. to 1s. 5½d. per gallon.

Pyridines are easy at about 15s. per gallon for 90/160 grade and 17s. per gallon for 90/140 grade.

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A.R.P.

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GAS STOCKS AND SHARES

The initial payments for requisitioned India loans were responsible last week for a fairly heavy demand by way of reinvestment for the Funds and home rail stocks, and the news from Jugoslavia towards the close gave markets a more cheerful appearance than for some time past. Prices in most sections hardened—War Loan setting the pace with a rise to 105. Industrials which had been dull at the opening of the week showed a marked change in sentiment, and the leaders hardened, including several which had reacted earlier on Budget fears, such as tobacco and brewery issues. Even oil shares brightened up, though little change took place among rubber and tea shares.

The volume of business in the Gas Market was also distinctly heavier last week, although it is regrettable to notice that up to Thursday, at any rate, the majority of movements were in a downward direction. One bright feature was a sharp rise of 12½ in the stock of the Oriental Gas Company to 122½, business being recorded at 125. Tottenham stocks rose a further 3 points to 72½ and transactions were recorded at 74½, against the previous level of 69⅞. On the other hand, Gas Light units fell another 6d. to 10s., Commercial and South Metropolitan continued their downward trend and a heavy fall of 9 points to 95½ occurred in Alliance and Dublin. There were no changes of note in either the Supplementary or Provincial Lists.

In the interests of paper economy, the full Stock Lists shown below will appear in future once a month only, and will be found in the "JOURNAL" published on the first Wednesday of each month. During the intervening period any weekly price changes will be recorded in the Stock Market Report.

Quotations on the London and Provincial Stock Exchanges

OFFICIAL LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 27.	Rise or Fall on week.
1,767,439	March 10	7	6	Alliance & Dublin Ord. ...	93—98	—9
374,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	90—95	...
957,608	Nov. 4	5	5	Assed. Gas & Water U'd'ts Ord.	11/6—13/6	...
500,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	14/6—16/6	...
535,545	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	14/6—16/6	...
336,646	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	10/—13/-	...
561,370	Feb. 17	7	7	Barnet Ord. 7 p.c.	95—100	...
300,000	Oct. 14	1/9⅜	1/4⅛	Bombay, Ltd.	19/6—21/6	...
690,407	Feb. 24	7	7	Bournemouth 7 p.c. max. ...	110—115	...
362,025	Dec. 16	4	4	Do. 4 p.c. Deb. ...	87—92	...
659,955	March 3	4⅜	2½	Brighton, &c., 5 p.c. Con. ...	60—65	—½
855,000	March 10	6	6	Brit. Gas Light Ord.	70—80	...
545,000	Dec. 16	5½	5½	Do. 5½ p.c. 'B' Cum. Pref	105—115	...
120,000	,,	4	4	Do. 4 p.c. Red. Deb.	75—80	...
10,000	Nov. 6 '33	6	4	Cape Town, Ltd., 4½ p.c. Cu. Pf.	¼—¾	...
626,860	Feb. 3	6	6	Cardiff Con. Ord.	87—92	...
24,500	Sept. 23	7	7	Colombo 7 p.c. Pref.	19/—21/-	...
764,169	March 24	-/11.48	-/11.48	Colonial Gas Assn. Ltd. Ord. ...	13/6—15/6*	—/6
400,000		1/3.30	1/3.30	Do. 8 p.c. Pref. ...	18/6—20/6*	—/6
1,748,935	July 22	2	3	Commercial Ord.	28—33	—2½
620,000	Dec. 9	3	3	Do. 3 p.c. Deb.	57—62	...
286,344	Feb. 17	5	5	Do. 5 p.c. Deb.	85—90	...
807,560	Feb. 24	6	6	Croydon sliding scale	80—85	...
644,590	,,	5	5	Do. max. div.	75—85	...
620,385	Dec. 30	5	5	Do. 5 p.c. Perp. Deb. ...	95—100	...
179,500	Feb. 10	5	5	East Surrey 'B,' 5 p.c.	60—70	...
176,461	Dec. 16	5	5	Do. 5 p.c. Deb. (Irred.)...	87—92	...
250,000	Nov. 11	4	6	Gas Consolidation Ord. 'B' ...	13/6—14/6	...
250,000	Nov. 11	4	4	Do. 4 p.c. Red. Cum. Pref.	15/—17/-	...
19,122,910	July 29	3⅜	4½	Gas Light & Coke Ord. ...	9/6—10/6a	—/6
2,600,000	,,	3½	3½	Do. 3½ p.c. max.	38—43	...
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	61—66	...
2,993,000	July 8	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	68—73	...
8,602,497	Dec. 2	3	3	Do. 3 p.c. Con. Deb. ...	71—76	+1
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	102—107	+1
3,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	100—105	+1
700,000	March 10	3½	3½	Do. 3½ Red. Deb. ...	79—84*	...
5,600,000	May 13	4	8	Imperial Continental Cap. ...	42—47	...
43,820	Jan. 27	3½	3½	Do. 3½ p.c. Red. Deb. ...	75—80	...
231,978	Feb. 24	5	5	M.S. Utility 'C' Cons.	66—71	...
918,657	,,	4	4	4 p.c. Cons. Pref.	70—75	...
675,000	Nov. 11	†4	†4	Montevideo, Ltd.	52—57	...
300,000	Nov. 18	7	9	Oriental, Ltd.	120—125	+12½
368,537	Dec. 9	8	6½	Plymouth & Stonehouse 5 p.c.	88—98	...
621,667	Feb. 3	7½	7½	Portsmouth & Gosport Cons.	90—95	...
648,999	Sept. 16	1/1	1/1½	Severn Val. Gas Cor. Ld. Ord.	13/—15/-	...
597,972	March 10	-/10⅜	-/10⅜	Do. 4½ p.c. Cum. Pref. ...	15/6—17/6	...
2,528,714	Sept. 2	1/-	-/7⅛	South East'n Gas Cn. Ld. Ord.	7/—9/-	...
1,000,000	March 3	-/10⅜	-/10⅜	Do. 4½ p.c. Red. Cum. Pref.	13/6—15/6	...
1,068,869	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	10/—12/-	...
6,709,895	Aug. 5	4	4	South Met. Ord.	38—43	—1
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	75—80	—2½
850,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	60—65	...
1,895,445	Dec. 30	3	3	Do. 3 p.c. Perp. Deb. ...	60—65	+1
1,000,000	Jan. 15	5	5	Do. 5 p.c. Red. Deb. ...	98—103	...
1,543,795	Feb. 24	4	2	South Suburban Ord. 5 p.c. ...	55—65	...
512,825	,,	5	5	Do. 5 p.c. Perp. Pref. ...	78—83	...
500,000	,,	4	4	Do. 4 p.c. Perp. Pref. ...	60—65	...
250,000	,,	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	78—83	...
888,587	Dec. 16	5	5	Do. 5 p.c. Perp. Deb. ...	93—98	...
750,541	Feb. 10	5	2	Southampton Ord.	50—60	...
350,000	Feb. 10	5½	5½	Swansea 5½ p.c. Red. Pref. ...	91—96	...
1,076,495	Feb. 24	5	5	Tottenham & District Ord. ...	70—75	+3
338,555	,,	5	5	Do. 5 p.c. Pref.	78—83	...
453,380	Dec. 9	4	4	Do. 4 p.c. Perp. Deb. ...	76—81	...
1,247,505	May 20	4	6	U. Kingdom Gas Cor. Ord. ...	12/—14/-	—1/-
1,085,952	Nov. 25	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	13/6—15/6	...
772,709	,,	4	4	Do. 4 p.c. 1st Red. Cum.Pref.	13/—15/-	...
745,263	Dec. 16	4½	4½	Do. 4½ p.c. 2nd Non.Cum. Pf.	11/—13/-	—1/-
1,200,000	March 17	3½	3½	Do. 3½ p.c. Red. Deb. ...	84—89	+1
380,608	Aug. 5	7	6½	Uxbridge, &c., 5 p.c.	80—90	...
1,371,138	March 3	4	4	Wandsworth Consolidated ...	65—70	...
2,525,768	,,	4	4	Do. 4 p.c. Pref.	60—65	...
1,343,964	Dec. 16	5	5	Do. 5 p.c. Deb.	92—97	...
383,745	,,	4	4	Do. 4 p.c. Deb.	75—80	...
558,342	Feb. 24	5	5	Watford & St. Albans Ord. ...	84—89	—2
300,000	Dec. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	84—89	...

SUPPLEMENTARY LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 27.	Rise or Fall on week
351,685	Dec. 16	5	5	Brighton, &c., 5 p.c. Perp. Deb.	88—93	...
28,700	,, 17	5½	5½	Do. 5½ p.c. Red. Deb. 1942 ...	95—100	...
415,250	,, 23	4	4	Bristol Gas Co., 4 p.c. New Deb.	88—93	...
140,205	Feb. 3	7	7	Cambridge, &c., 7 p.c. Cons. 'B'	100—110	...
295,932	March 3	5	5	Cheltenham, 5 p.c. Cons. Ord....	85—90	...
42,500	Dec. 16	4	4	Do. 4 p.c. Perp. Deb....	75—80	...
150,000	Feb. 24	4	4	Croydon Gas, 4 p.c. Pref. (Irr.)	70—75	...
130,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	75—80	...
146,700	Feb. 10	5½	5½	East Surrey, 5½ p.c. Pref. 'A' ...	80—90	...
53,220	,,	10	6	Do. 6 p.c. Cum. Pref. ...	90—100	...
	Aug. 19	6	4	Eastbourne, 'B' 3½ p.c.... ...	30—50	...
117,425	Feb. 5	8	8	East Wight 5 p.c. Cons. Ord. ...	100—110	...
239,135	Nov. 11	5	5	Gas Consolidation 'A' Ord. (£1)	13/—15/-	...
156,600	Feb. 24	5	5	Hampton C't, 5 p.c. Cons. Ord.	67—72	...
18,000	Dec. 2	7	7	Malta & Med'n., 7 p.c. 1st Pref.	50—60	...
10,845	,, 2	7½	7½	Do. 7½ p.c. 2nd Pref.	50—60	...
50,000	Feb. 24	£5 19 6	£5 4 6	Mid. South. Util., 'A' Cons. 5 p.c.	60—70	...
65,000	Aug. 12	5	5	North Middlesex, 5 p.c. Pref....	87—92	...
70,000	Sept. 9	5	5	Plymouth & Stone., 5 p.c. Deb.	85—90	...
76,501	Dec. 30	4	4	Reading, 4 p.c. Perp. Deb. ...	70—75	...
74,777	Sept. 30	4	4	Romford, 4 p.c. Debs. (Reg.) ...	77—82	...
21,000	Dec. 16	5	5	Slough, 5 p.c. Perp. Deb. ...	87—92	...
211,740	,, 30	5	5	Southampton, 5 p.c. Red. Deb.	90—95	...
363,575	Dec. 30	5	5	Tottenham, 5 p.c. Reg. Red. Mt.	94—99	...
202,019	Oct. 14	6¾	6¾	Tunbridge Wells, 4 p.c. Scale ...	67—72	...
135,257	June 10	5	5	Uxbridge &c., 5 p.c. Perp. Deb.	90—95	+2

PROVINCIAL EXCHANGES

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 21.	
804,948	March 10	5	5	Bath Cons.	94—98*	...
122,577	July 22	7	6	Blyth 5 p.c. Ord.	100—105	...
1,667,250	Feb. 24	5	5	Bristol, 5 p.c. max.	84—86	...
120,420	Dec. 16	4	4	Do. 1st 4 p.c. Deb.	92½—94½	...
415,250	,,	4	4	Do. 2nd 4 p.c. Deb. ...	91—94	...
328,790	,,	5	5	Do. 5 p.c. Deb.	107—110	...
157,150	Feb. 3	5	6½	Chester 5 p.c. Ord.	98—101	...
92,500	Dec. 16	4	4	Do. 4 p.c. Pref.	79—81	...
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	79—84	...
41,890	,,	4	4	Do. 4 p.c. Red. Deb. ...	93—97	...
542,270	Feb. 10	6	9	Derby Cons.	98—103	...
55,000	Dec. 16	4	4	Do. 4 p.c. Deb.	75—80	...
10,000	March 3	10	10	Great Grimsby 'A' Ord. ...	155—165	...
6,500	,,	10	10	Do. 'B' Ord. ...	155—165	...
79,000	,,	10	10	Do. 'C' Ord. ...	145—155	...
732,000	Feb. 24	4	4	Hartlepool G. & W. Cn. & New	61—63	...
2,167,410	Feb. 17	6	6	Liverpool 5 p.c. Ord.	91—93	...
245,500	Dec. 16	5	5	Do. 5 p.c. Red. Pref. ...	97½—100½	...
306,083	Jan. 15	4	4	Do. 4 p.c. Deb.	98—100	...
20,000	Dec. 23	5	5	Long Eaton 5 p.c. Pref.	9—11	...
80,000	,,	5	5	Do. 5 p.c. Deb.	87—92	...
2,430,267	Feb. 10	5	5¼	Newcastle and Gateshead Con.	16/9—17/9a	...
682,856	,,	4	4	Do. 4 p.c. Pref.	79—81	...
776,706	Dec. 23	3½	3½	Do. 3½ p.c. Deb.	80—85	...
277,285	Oct. 21	5	5	Do. 5 p.c. Deb. '43 ...	97—102	...
274,000	March 17	5	5	Newport (Mon.) Ord.	87—91*	...
13,200	Sept. 16	8⅜	7	Pontyp'l Gas & W. 10 p.c. 'A'	11½—12½	...
13,600	,,	6	5	Do. 7 p.c. 'B'	9½—10½	...
40,000	,,	5	6	Do. 7 p.c. 'C'	9½—10½	...
106,280	Feb. 3	10	10	Preston 'A' 10 p.c.	157—167	...
188,219	,,	7	7	Do. 'B' 7 p.c.	113—122	...
1,806,339	Feb. 24	6½	6½	Sheffield Cons.	111½—113½	...
95,000	Jan. 6	4	4	Do. 4 p.c. Deb.	96—98	...
332,351	Feb. 3	6	6	Sunderland 6 p.c. max. ...	107—110	...
192,150	Feb. 12	5	5	Weston-super-Mare Cons. ...	79—84	...
64,338	Dec. 30	4	4	Do. 4 p.c. Deb.	80—85	...
33,340	,,	7½	7½	Do. 7½ p.c. Deb.	135—140	...

a.—The quotation is per £1 of Stock. * Ex. div. † Price free of income-tax.

En passant

When Fortune means
to men most good
she looks upon them
with a threatening eye
Shakespeare (King John)

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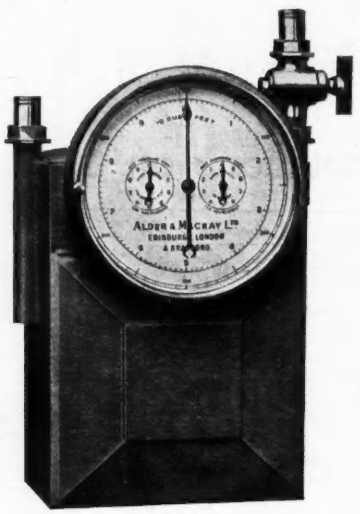
A. & M. Dry Demonstration Meter . . . . specially designed for Showroom or Cookery Demonstration work.



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ATMOSPHERE IN FURNACE CONSISTS OF PRODUCTS OF COMBUSTION THUS REDUCING OXIDATION TO A MINIMUM.

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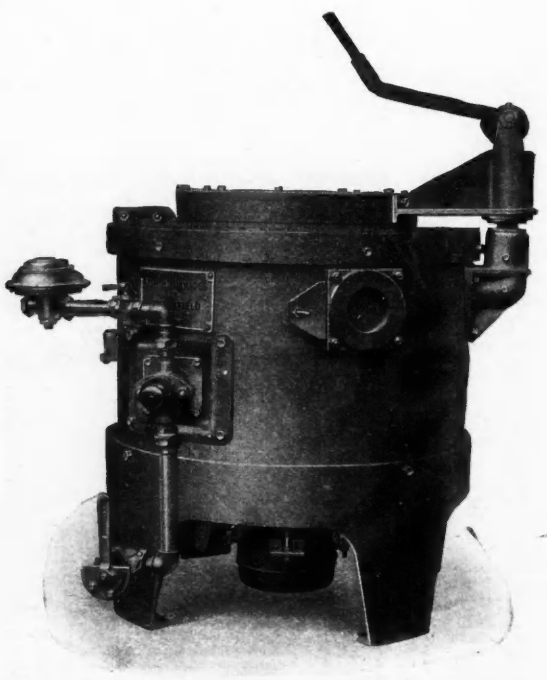

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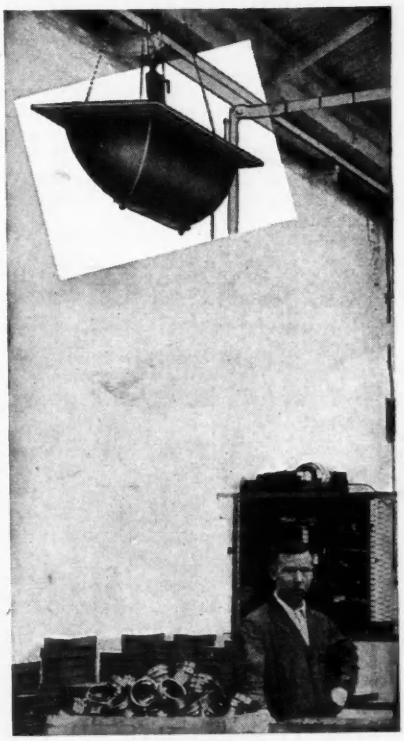

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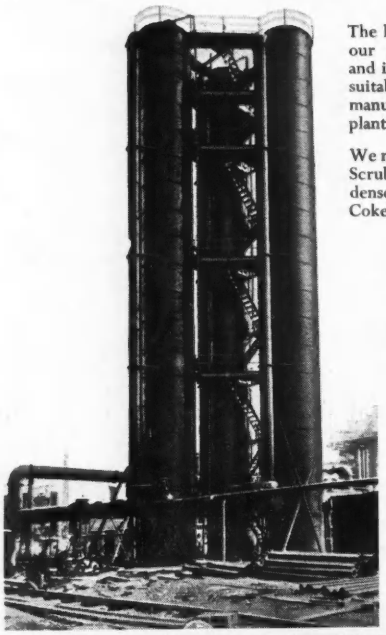

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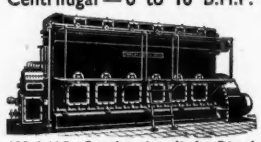

600 B.H.P. Crossley six-cylinder Diesel engine.

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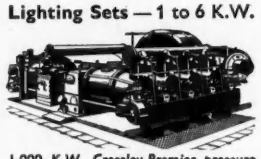

1,000 K.W. Crossley-Premier pressure charged vis-à-vis Diesel.

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CP200/43

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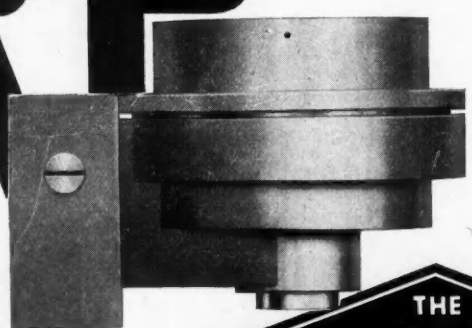
EMERGENCY CONTROL FOR STREET LIGHTING



This appliance is arranged to extinguish the illumination of the Mantles, leaving only a small cone of gas at the nozzle.

It operates on reduction of pressure at works or District Governor to 5/10ths below lowest normal working pressure, and lamps are re-lit when the original pressure is restored.

Service to PrivateConsumers is maintained.

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